USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Monitoring small upland watersheds to determine ground water–surface water interactions and runoff processes.
Focus Categories: HYDROL
Keywords: Hillslope Hydrology, Saturated source areas, Runoff Processes.
Duration: March 1, 2000 to February 28, 2001
Federal Funds Requested: **$ 22,500.**
NonFederal Funds: $ 46,808.
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Congressional District: 2nd

Statement of Critical Regional or State Water Problem

Most hydrology textbooks and reference manuals show runoff coefficients, such as the 'C' value for the Rational Equation or the Curve Number (CN), increasing as watershed slopes increase. Recent observations and preliminary data from small watersheds being monitored by the PI's exhibit the opposite relationship. We recently observed that a flat, 8 acre watershed produced quicker and more runoff than a steep, 41 acre watershed (See Figure 2 below). An 18 acre watershed with a flat, frequently saturated area near the outlet produced an intermediate amount of runoff. The observed phenomena are thought to be due to position of the watershed in the landscape, land-use/land-cover, and different sensitivities to antecedent moisture conditions. We also hypothesize that there are a variety of runoff mechanisms at work. In the flat watersheds near hilltops, rising water tables result in saturated source runoff, while mostly shallow subsurface flow occurs in the steeper watersheds.

A number of medium-to-large sized watersheds (4 square miles and larger) have been monitored for years by the U.S. Geological Survey in Connecticut. However, there is a lack of rainfall–runoff data for very small watersheds for determination of runoff coefficients for the prediction of hydrologic impacts associated with land use changes. Values of coefficients currently used in the state were developed on mostly urbanized or agricultural fields in other parts of the country where the Hortonian runoff mechanism dominates. However, there are limited data available to assess the importance of the position of the water table and the ground water–surface water interactions which are critical in Connecticut upland hydrology. Better rainfall–runoff data, including the roles of landscape position and land use, are needed by state (e.g. CT DEP and DOT) and federal agencies (USGS, NRCS), consultants and researchers for assessing runoff potential of projects, for the validation and calibration of models, and for testing different runoff theories. Furthermore, the USGS statewide regression equations are not applicable for headland watersheds smaller than 1 square mile.

Statement of Results or Benefits

The results of the proposed research will enhance the understanding of the ground water–surface water interactions as related to runoff in upland areas typical of Southern New

England. The importance of landscape position, land use and watershed characteristics can be better assessed. In particular, the relationship of the water table level and resultant extent of saturated source areas (SSA's) will be compared with runoff rates to develop new predictive methods based on topography, geology, and hydrometeorology.

The results should directly benefit engineers in better design of hydraulic structures. The results will also assist local, state and federal agencies in the analysis and review of hydrologic impacts of development projects. The ability to predict the spatio-temporal variability of SSA's in the landscape will provide opportunities to evaluate existing models and aid in the calibration of new models. Predictions of the extent of SSA's are also useful to assess water quality impacts for different landuses and management schemes such as fertilizer applications, buffer zones, and land development.